APPENDIX B

WATER QUALITY MONITORING REPORT

City of Seattle

LOWER DUWAMISH WATERWAY SLIP 4 EARLY ACTION AREA

Water Quality Monitoring Report

Submitted to
U.S. Environmental Protection Agency, Region 10
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Seattle, WA 98101

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ACRONYMS AND ABBREVIATIONS

BMP	best management practice
COC	chemical of concern
EAA	early action area
EPA	U.S. Environmental Protection Agency
LDW	Lower Duwamish Waterway
NBF	North Boeing Field
NTU	nephelometric turbidity unit
PCB	polychlorinated biphenyl
RACR	removal action completion report
SAP	sampling and analysis plan
TSS	total suspended solids
WAC	Washington Administrative Code
WQMP	water quality monitoring plan

1 INTRODUCTION

This water quality monitoring report is a part of the removal action completion report (RACR) for the removal action of contaminated marine sediments and adjacent bank areas at the Slip 4 Early Action Area (EAA) of the Lower Duwamish Waterway (LDW) Superfund Site located in Seattle, Washington (Figure 1-1). The removal action implemented the U.S. Environmental Protection Agency's (EPA's) selected alternative as defined in its Action Memorandum (USEPA 2006). The City of Seattle (City) conducted the Slip 4 sediment removal action. The construction quality assurance plan (Integral 2010a) outlined the overall approach to construction quality assurance and the role of the water quality monitoring activities in relation to other project elements. The water quality monitoring plan (WQMP) outlined specific protocols for performing quality assurance activities related to in-water work (Integral 2010b).

Within the Slip 4 EAA, polychlorinated biphenyls (PCBs) were the chemicals of concern (COC) in the sediments. The defined removal boundaries encompassed approximately 3.6 acres. The primary objective of the removal action was to reduce the concentrations of contaminants in post-cleanup surface sediments (biologically active zone [0–10 cm]) to below the Washington State Sediment Quality Standards for PCBs and other chemicals. This was accomplished by dredging contaminated sediments followed by placement of overlying clean capping material. The sediment removal action is expected to significantly reduce unacceptable risks to the aquatic environment resulting from potential exposure to contaminants in sediments in the slip. This cleanup is also expected to reduce potential human health risks associated with PCBs in sediment within the LDW.

On May 23, 2011, EPA issued a Clean Water Act Section 401 Water Quality Certification that defined required water quality monitoring requirements and applicable water quality criteria as performance standards (USEPA 2011). The Contractor was required to conduct all operations in compliance with these performance standards.

1.1 REPORT OBJECTIVES

This report documents the results of monitoring activities that were performed to assess potential impacts to surface water resulting from in-water construction activities at Slip 4, and presents data that was collected to ensure compliance with water quality criteria. The report also describes how construction activities were modified to ensure protection of the environment when exceedances of water quality criteria occurred.

The report also summarizes the water quality monitoring procedures and related quality assurance protocols, and describes best management practices (BMPs) that were employed to reduce potential water quality impacts during the work.

1.2 REPORT ORGANIZATION

The remaining sections of this document describe the field monitoring program and sampling that was conducted during the construction activities described in the WQMP (Integral 2010b). Section 2 discusses the BMPs employed during the project to protect water quality. Section 3 provides a description of the field sampling activities. Section 4 discusses deviations from the WQMP. Section 5 describes the field changes and contingency BMPs. Quality assurance/quality control samples are described in Section 6. References are provided in Section 7.

Supporting information is provided in the following attachments:

- **Attachment A.** Field Notes and Calibration Information
- **Attachment B.** Water Quality Monitoring Forms
- **Attachment C.** Surface Water Sample Collection Forms
- **Attachment D.** Surface Water Laboratory Reports
- **Attachment E**. Photos of Water Quality Monitoring and Surface Water Sampling.

2 BEST MANAGEMENT PRACTICES

A variety of physical and operational BMPs were identified in the biological assessment (Integral 2007) as a means of reducing potential water quality impacts during all phases of the removal action. This section provides a brief evaluation of their use during removal action construction, as well as additional BMPs employed by the Contractor.

BMPs identified in the biological assessment and/or provided by the Contractor are listed below, in bold. A summary of the use and effectiveness of each BMP is provided.

- **Sequencing dredging and capping activities to reduce the duration that dredged/excavated surfaces remain exposed before capping.**

  Given the need for post-dredge/excavation document sampling and verification survey, it was necessary to complete 100 percent of the dredging and bank excavation prior to capping. This also limited the number of material barges that needed to be within the slip at any given time. However, scour protection capping was provided in front of the outfalls during the shift immediately following dredging within the same area.

- **Requiring excavation from the top of the slope down, and capping from the bottom of the slope upward, to reduce the potential for sloughing.**

  The Contractor was observed to sequence slope excavation and slope capping in the manner stated above. Some minor sloughing of bank filter material did occur during placement, but this did not appear to impact water quality conditions.

- **Requiring bulkhead demolition concurrent with bank excavation to reduce the potential for sloughing.**

  The Contractor was observed to perform bank excavation behind bulkheads, prior to demolition, as stated above.

- **Using an environmental dredge bucket to the extent practical, considering debris and other site conditions and with the overall goal of minimizing sediment resuspension during dredging.**

  The Contractor attempted to use an environmental bucket at the outset of dredging operations. However, due to the heterogeneous nature of the sediments and debris within the slip, the bucket proved ineffectual. "Bites" often failed to fully close, resulting in released sediment from the bucket. When the bucket did fully close, it tended to capture an excessive amount of water, which would then need to be decanted from the barge. Given that there had been no turbidity exceedances prior to the use of the environmental bucket, and for the reasons

stated above; the Contractor was allowed to switch back to the standard digging bucket.

- **Eliminating multiple bites with the dredge bucket.**

  The Contractor was observed to take only single bites of material during dredging.

- **Eliminating sweeping with the bucket or stockpiling of dredged material on the bottom.**

  The Contractor was not observed to sweep the bottom while dredging, nor stockpile dredged material on the bottom. Bank material was stockpiled above the water line.

- **Eliminating the use of grading equipment below the water line.**

  Grading equipment was observed to stay above the water line at all times.

- **Requiring the filtering of return water entering Slip 4 from the materials barge, as material is dewatered on the barge. Material may be mounded on the materials barge to promote drainage.**

  The Contractor provided a barge dewatering and filtration system, which included ballasting the barge toward a water collection cell, providing a baffle consisting of ecology blocks and straw wattles between the main portion of the barge and the collection cell, providing a pump system from the holding cell to a flexi-float supported geotextile bag filter, on top of a drainage mat consisting of GAC placed between layers of geofabric.

- **Eliminating overfilling of the materials barge.**

  Barge loads were observed to be held to roughly 800 CY/barge based on observable draft. Material loading was restricted to the top of bin walls, with no significantly uneven mounding.

- **Avoiding or minimizing tug activity in Crowley's middle berth during dredging (to be coordinated between the City and Crowley).**

  While increased barge traffic was observed at the middle berth on November 3 and December 8, 2011, neither occurrence coincided with the Contractor's barge movements. No significant increase in turbidity was reported during these occurrences.

- **Anticipating relatively low dredge production rates of 400–1,000 CY/day.**

  Typically, the Contractor shipped roughly 800 CY of material (one barge load) per day.

- **Controlling liquids and avoiding spillage from transloading activities.**

  Barges remained in the slip to dewater for at least 8 hours prior to shipping. In addition, water was pumped to the filtration system from the holding cell and standing pools in the main containment area prior to transport.

  The tower crane at the transloading facility was equipped with a dribble chute. The chute captured any dripped material from the crane bucket and directed it back to the material barge.

  Material spilled from the excavator bucket during the loading of containers was hosed off with a pressure washer and directed to a sump where it was then pumped back to the containment vault.

- **Placement of a rock berm at the southern boundary of the removal action area before dredging, to potentially limit offsite transport of "mud wave" turbidity.**

  The boundary berm was placed on October 3 and 4, 2011, prior to any in-water dredging or excavation. On October 17 and 19, 2011, turbidity measurements were taken near the sediment elevation, both upstream and downstream of the boundary berm. This monitoring event is described in more detail in Section 3.1.1. The measurement results indicate that the boundary berm likely had no significant effect in reducing turbidity; however, it is still likely a beneficial BMP to prevent migration of dredge-generated residuals.

- **Operational controls.**

  The Contractor utilized a variety of techniques to reduce potential impacts to water quality. These include specific measures as dredging at the head of slip during low tide, excavating bank areas "in the dry", and adjusting the rate of release for cap materials to better pluviate material in thinner lifts.

  Following a turbidity exceedance on January 24, 2012, operational controls were adjusted to bring turbidity back into compliance (refer to Section 5).

- **Constructing and maintaining a containment berm or other confinement method in the re-handling area.**

  Temporary stockpiles were created adjacent to bank excavation work zones. All excavated soil and debris were transferred from the stockpiles to the barge for transport to the off-site transloading facility. Equipment did not routinely enter and exit exclusions zones, eliminating the need for traditional wheel-wash systems.

Equipment was decontaminated following bank excavation. A portable containment berm and wash pad was used to collect decontamination water from pressure washers.

- **Collecting liquids from upland containment areas.**

  Stockpile runoff and decontamination water was pumped to a Baker tank and collected by Marine Vacuum Service for disposal at its facility.

- **Cutting of pier piling.**

  Concrete piles were cut to within 1 ft of the mudline using a pile shear.

- **Avoidance of disturbance to subsurface materials.**

  Disturbance of the boundary area outside the project limit was unavoidable given the need for the derrick barge to spud down prior to placing cap material. Pre- and post-construction analytical sampling within the boundary area indicated that the disturbance led to an increase in contaminant concentrations within that area.

  As a contingency, a thin layer (9-in. nominal) of waterway cap material was placed in the boundary area (refer to Section 3.17 of the RACR).

3 WATER QUALITY MONITORING ACTIVITIES

Water quality monitoring took place during removal action construction to monitor surface water quality within Slip 4 and ensure that all in-water construction activities were conducted in compliance with 401 Certification, including general water use and criteria classes (WAC 173-201A-030) for turbidity, dissolved oxygen, toxic conditions, and the numeric toxic substances criteria (WAC 173-201A-040). In-water removal action construction activities occurred between October 3, 2011 and February 7, 2012. In general, water quality monitoring followed the design and methods described in the WQMP. Deviations from the WQMP are described in Section 4.

Observations of transloading operations were conducted on a regular basis to ensure compliance with the RAWP (Integral 2011) and the 401 Certification. Details of the transloading observations are provided in Section 3.3.

Additional field observations, including sampling times, weather conditions, water conditions, and other anecdotal information were noted in field notes (Attachment A) and on water quality monitoring forms (Attachment B). Representative photos showing field activities are presented in Attachment E.

3.1 WATER QUALITY MONITORING

Two pre-established monitoring/sampling stations were used. The compliance sampling station was located mid-slip at 100 m from the removal action boundary. The ambient sampling station was located at the entrance of the slip just off the LDW main channel (Figure 3-1). *In situ* water quality values and laboratory results from water samples were compared to state water quality standards for compliance, as defined in the 401 Certification.

In situ water quality measurements were collected during bank excavation, sediment dredging, and barge dewatering, pier demolition and capping construction activities. The frequencies of measurement are described in detail for each type of construction activity in the following subsections. *In situ* water quality measurements included turbidity, dissolved oxygen, temperature, salinity, pH, and conductivity. Water quality monitoring forms are included in Attachment B. Water quality readings are summarized in Table 3-1. Real-time turbidity measurements were used to monitor compliance with the water quality standards and to determine appropriate response actions in the event of a water quality exceedance. The real-time turbidity measurements were also used to assess the need for collection water quality samples for COC analysis.

3.1.1 Bank Excavation, Sediment Dredging, and Barge Dewatering

Bank excavation and sediment dredging occurred concurrently, eliminating the need for separate monitoring frequencies as previously described in the WQMP. During the first 10 days of active, in-water work, *in situ* water quality measurements were generally collected twice daily at both the ambient and compliance stations. After the first 10 days, *in situ* water quality measurements were taken twice daily at the ambient and compliance stations, on two non-consecutive days per week (Table 3-1). Turbidity measurements did not indicate any exceedances within the slip during dredging and excavation activities. No distressed/dying fish or large silt plumes attributable to dredging and excavation activities were observed. There were no significant spills.

Dredged materials were required to gravity drain on decant barges within the removal area boundary for a minimum of 8 hours to reduce free draining liquids, prior to being transported for disposal. The dewatering generally occurred concurrent with dredging and excavation activities and in the same work area; therefore, water quality monitoring also assessed potential impacts from return water released from the decant barge.

The Contractor utilized a barge dewatering/filtration system consisting of a water holding cell separated form the main barge area by a filtration baffle, a pump from the holding cell to a filtration bag, and a drainage mat beneath the filtration bag consisting of granular activated carbon (GAC) sandwiched between layers of geofabric (Figure 3-2). On October 14, 2011 turbidity measurements were taken at four locations along the dewatering/ filtration system to evaluate its effectiveness. The measured turbidity in the main barge area was 92.4 nephelometric turbidity units (NTUs). Turbidity in the barge holding cell was 87.4 NTUs. Turbidity of water discharging from the filter bag measured 39.0 NTUs. Lastly, turbidity of discharge through the GAC drainage mat was 28.5 NTUs. These results suggest that the barge dewatering/filtration system was effective at reducing the turbidity of the return water.

On October 17-19, 2011 turbidity measurements were collected upstream and downstream of the boundary berm during dredging activities. These measurements were intended to determine if the berm had any effect on the turbidity leaving the removal area, associated with near-bottom nepheloid or "mud wave" transport often encountered from resuspension during dredging projects. Turbidity measurements were collected at three paired locations in two transects; one upstream and one downstream of the berm (Figure 3-3). The first set of measurements was collected approximately 3 ft above mudline. The change in turbidity between the upstream and downstream locations was small: 1.2, 0.0, and 1.5 NTUs (Attachment C, pp. 29-30). The second set of measurements was collected on October 19, but from approximately 0.5 ft above mudline. The change in turbidity between the upstream and downstream location was again small: –0.4, –1.5, and –1.2 NTUs. All turbidity measurements were relatively low, ranging from 2.9 to 5.6 NTU.

These results indicate that nepheloid or "mud wave" transport was not likely a significant transport mechanism for residuals near the boundary berm, since the dredging was several hundred feet away from the berm. Thus, the near-bottom transport that the boundary berm was intended to reduce was not an active process.

3.1.2 PIER DEMOLITION AND CAPPING

Pier demolition and capping occurred concurrently, eliminating the need for separate monitoring frequencies as previously described in the WQMP. *In situ* water quality measurements were taken twice daily at the ambient and compliance stations, on non-consecutive days per week during the pier demolition and capping activities that occurred in 2011 and twice daily at the ambient and compliance stations approximately one day per week in 2012 (Table 3-1). A turbidity exceedance at the compliance station occurred on January 24, during the placement of capping materials. The contingency procedures for documentation, agency notification, and modification of construction operations were followed as specified in the WQMP and are described in detail in Section 5. No additional WQ exceedances were observed during the pier demolition.

3.2 SURFACE WATER SAMPLING

Surface water grab samples for laboratory analysis were collected on October 7, 11, and 13, 2011. In general, surface water sampling followed the methods and procedures described in the WQMP. Deviations from the WQMP are described in Section 4. Sample collection was accomplished with a Niskin bottle and the samples were submitted for analysis of COCs (total suspended solids [TSS] and PCB Aroclor concentrations). Water sample collection corresponded approximately to the third, fifth, and seventh days after initiation of in-water bank excavation and the third and fifth days after initiation of sediment dredging. On each of these days, one water grab sample was collected from both the ambient and compliance stations at the depth with maximum turbidity (Figure 3-4). On October 7 and 13, replicate samples were also collected and analyzed. All TSS and PCB analyses were performed on a rush basis (24–48 hours) in order to provide timely information about possible exceedances of the 10 μg/L PCB acute water quality standard, and allow for appropriate modifications to the construction activities. The TSS results were utilized for assessing general water quality; however; no numeric water quality standard was established for TSS in the 401 Certification.

Laboratory results show a range of TSS values from 5.1 to 21.3 mg/L and all PCB concentrations were below laboratory detection limits (Table 3-2). The complete laboratory reports are provided in Attachment D.

3.3 TRANSLOADING OBSERVATIONS

Transloading of material from barges occurred at the Lafarge transloading facility, approximately 2 miles downstream of Slip 4. Observations of the transloading operations were conducted twice weekly, on non-consecutive days, in October and November during the time that bank excavation and dredge materials were being transported from Slip 4. During observations of the transloading process, no liquids or solids were observed being released to the river. Observations are summarized in field notes, which are located in Attachment C.

4 MONITORING PLAN DEVIATIONS

Water quality monitoring was conducted in general accordance with the WQMP. During the course of the project, however, several deviations from the plan occurred and are noted in the following sections.

4.1 WATER QUALITY MONITORING

- Minor variations in the compliance and ambient sample locations occurred throughout the project due to factors such as wind, current, and occasional obstructions (barges) that blocked access to the sample locations. All of the measurements are near the center of the channel and within 50 ft of the proposed sample locations. The data collected are believed to be representative of the proposed sample locations.
- The WQMP sampling scheme specified that water quality measurements would occur at slack and ebb tides. Due to the daily variability of the construction activities and the shifting tide schedule, water quality measurements were not always collected during those times and resulted in some measurements being collected during flood tide. Flood tide water quality measurements were collected on October 4, 7, 10, 12, and 28, and November 10, 2011.
- The WQMP specified that *in situ* water quality data for conventional parameters would be obtained with a YSI multiprobe. On October 4, 2011, a Hydrolab MS5 multiprobe was used to measure water quality parameters due to a shipping delay of the YSI multiprobe.
- Some water quality parameters are missing in Table 3-1 for pH on October 4, 2011, and salinity on October 5, 2011, due to a failure to record these parameters in the field notes.

4.2 SURFACE WATER SAMPLE COLLECTION

- The WQMP specified that decontamination of the Niskin bottle include a rinse with methanol. A field change to the sampling and analysis plan (SAP) was issued on August 22, 2011, to indicate that if equipment decontamination required removal of residual oils, hexane would be used instead of methanol.
- The WQMP specified that decontaminated Niskin bottles be stored in a plastic bag when not in use. To avoid potential contamination that could have been introduced during storage, the Niskin bottle was fully decontaminated when taken out of storage, immediately prior to its deployment for sample collection.

- The removal action SAP specified that sample coolers would be maintained at a temperature of 4°C (±2°C) (Integral 2010c). One cooler delivered to the laboratory on October 7, 2011, was relinquished at a temperature of 8.9°C. This deviation did not affect data usability for this project, as none of the surface water samples in this cooler were analyzed.
- The SAP specified that sample coolers would be sealed with three chain-of-custody seals, *This End Up* and *Fragile* labels. This labeling was not done because all coolers were hand-delivered to the laboratory by the sample team.

5 CHANGES TO OPERATIONAL CONTROLS

A water turbidity exceedance of more than 10 NTUs over ambient conditions occurred at the compliance station at 10:20 a.m. on January 24, 2012. The recorded turbidity increase of near surface water during ebb tide was 17.4 NTUs (22.0 NTUs at the compliance station and 4.6 NTUs at the ambient station) (Table 3-1). Prior to this measurement, waterway cap placement in Removal Area 5 had been under way for approximately 3 hours. This exceedance prompted action following the water quality response mechanisms presented in Section 4.4 of the WQMP and described below.

Additional water quality monitoring was conducted at 11:35 a.m. near slack tide and the turbidity exceedance was verified with an observed near bottom turbidity increase of 15.9 NTUs (19.5 NTUs at the compliance station and 3.6 NTUs at the ambient station). Additional visual observations of potential turbidity sources were conducted within the slip, near the outfalls at the head of the slip (North Boeing Field [NBF] [60-in.], King County [24-in.], and I-5 [72-in.]), and the main river channel. Two discretionary turbidity monitoring locations were also added at the NBF and I-5 outfalls to help assess whether the source of the turbidity exceedance was related to Contractor operations or other possible sources (i.e., stormwater).

From visual surface observations of the turbidity plume in the vicinity of the compliance station, it was noted that the plume color appeared to match that of the waterway capping material. In addition, the Lower Duwamish main channel appeared generally less turbid than Slip 4. At the outfalls, which were all in nearly neutral flow conditions, stormwater entering the slip was relatively clear.

Turbidity was measured at the NBF and I-5 outfalls. Due to the nearly neutral flow conditions and difficulty in positioning the meter close enough to the outfalls to avoid conditions where mixing between the clear stormwater and the cloudy Slip 4 water was occurring, turbidity readings reflect mixing conditions. A first attempt at measuring stormwater turbidity at the NBF outfall resulted in a reading of 20.4 NTUs. A second attempt (from land) resulted in a turbidity reading of 15.7 NTUs. A single attempt at collecting a turbidity reading at the I-5 outfall resulted in a reading of 38.1 NTUs (Table 3-1). These readings were all observed to reflect mixing conditions between the high turbidity water in Slip 4 and low turbidity stormwater. Based on the visual observations and turbidity measurements, it was concluded that the elevated turbidity in the slip was directly attributable to capping operations.

Based on results of the monitoring activities, the Contractor was directed to modify its operations to reduce turbidity generation. The Contractor slowed the production rate about 10–20 percent and began to open the bucket closer to the waterline when placing cap material. Water quality monitoring was conducted the following day to assess the

effectiveness of the modified construction operations. Turbidity monitoring on both the ebb tide and slack tide on January 25, 2012, indicated no water quality exceedances at the Slip 4 compliance station. Based on these results, the construction modifications appeared to be appropriate for reducing turbidity generation in the vicinity of the capping operation and Slip 4.

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6 DATA MANAGEMENT AND REPORTING

The management and reporting of field and laboratory data generally follows the procedures outlined in the SAP (Integral 2010c) and the WQMP (Integral 2010b). Changes or additions to those procedures, based on the specific requirements of the WQMP, are discussed below.

Due to the rush nature of all analyses and their use in making immediate real-time decisions about construction activities, the laboratory results did not undergo data validation by an independent validator. The laboratory has provided a data package for each sample delivery group or analysis batch that is comparable in content to a full Contract Laboratory Program package (Attachment D). These packages contain all information required for a complete quality assurance review, including all the associated raw data so formal validation could be performed if subsequently required.

Preliminary data quality reviews were completed for each of the three data packages received from the laboratory. Results of the review indicate that all laboratory quality control limits were met for all analyses, with the exception of laboratory replicate analyses for TSS in sample delivery packages TQ80 and TS00. Relative percent difference values for total suspended solids in TQ80 and TS00 were 24.9 and 23.3, respectively. TSS results for these two data sets may have an associated bias or may be less precise, but are considered acceptable for project purposes. Affected TSS data include Samples SW0001, SW0002, SW0003, SW0012, SW0013, and SW0014.

7 REFERENCES

Integral. 2007. Lower Duwamish Waterway Slip 4 Early Action Area: Biological Assessment. Prepared for City of Seattle and King County, WA. Integral Consulting Inc., Mercer Island, WA.

Integral. 2010a. Lower Duwamish Waterway Slip 4 Early Action Area: 100% Design Submittal, Construction Quality Assurance Plan. Prepared for City of Seattle and King County. Integral Consulting Inc., Seattle, WA.

Integral. 2010b. Lower Duwamish Waterway Slip 4 Early Action Area: 100% Design Submittal, Water Quality Monitoring Plan. Prepared for City of Seattle and King County. Integral Consulting Inc., Seattle, WA.

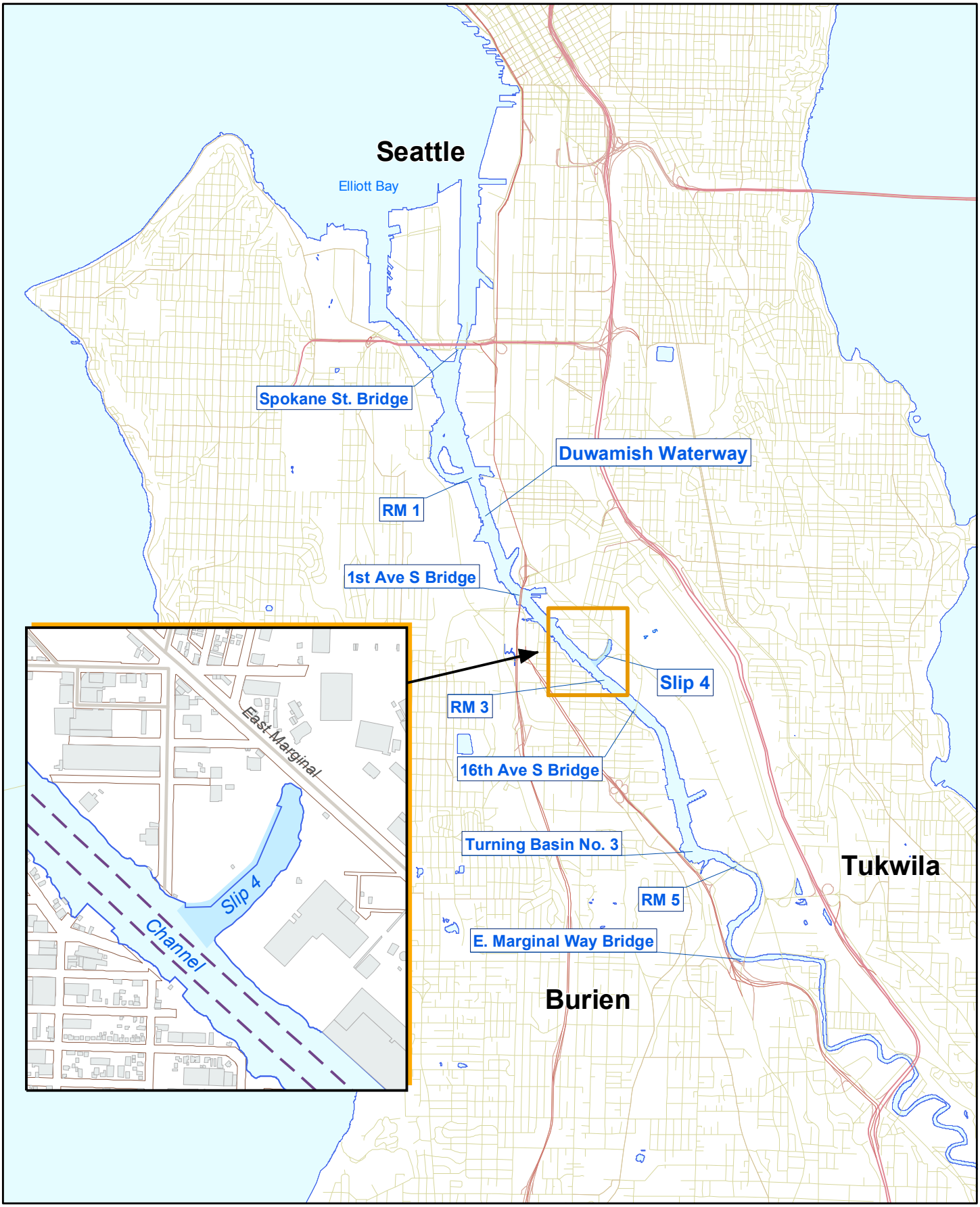
Integral. 2010c. Lower Duwamish Waterway Slip 4 Early Action Area: 100% Design Submittal, Removal Action Sampling and Analysis Plan. Prepared for City of Seattle and King County. Integral Consulting Inc., Seattle, WA.

Integral. 2011. Lower Duwamish Waterway Slip 4 Early Action Area: Final Removal Action Work Plan. Prepared for City of Seattle. Integral Consulting Inc., Seattle, WA. October 19.

USEPA. 2006. Action Memorandum for a Non-Time-Critical Removal Action at the Slip 4 Early Action Area of the Lower Duwamish Waterway Superfund Site, Seattle, Washington, dated May 3, 2006. U.S. Environmental Protection Agency, Region 10, Seattle, WA.

USEPA. 2011. Clean Water Act 401 Water Quality Certification, Removal Action of Contaminated Marine Sediments and Bank Areas at Slip 4 Early Action Area, Lower Duwamish Waterway Superfund Site, Seattle, Washington. U.S. Environmental Protection Agency, Region 10, Seattle, WA. May 23.

FIGURES



Map Document: (O:\Projects\Duwamish_OLY\Projects\Slip4_60%_DAR\SiteLocationMap.mxd)

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Map Feature Sources: King County GIS, Seattle Public Utilities, USACE, Ecology, and others.

Figure 1-1
Vicinity Map
Slip 4 Removal Design

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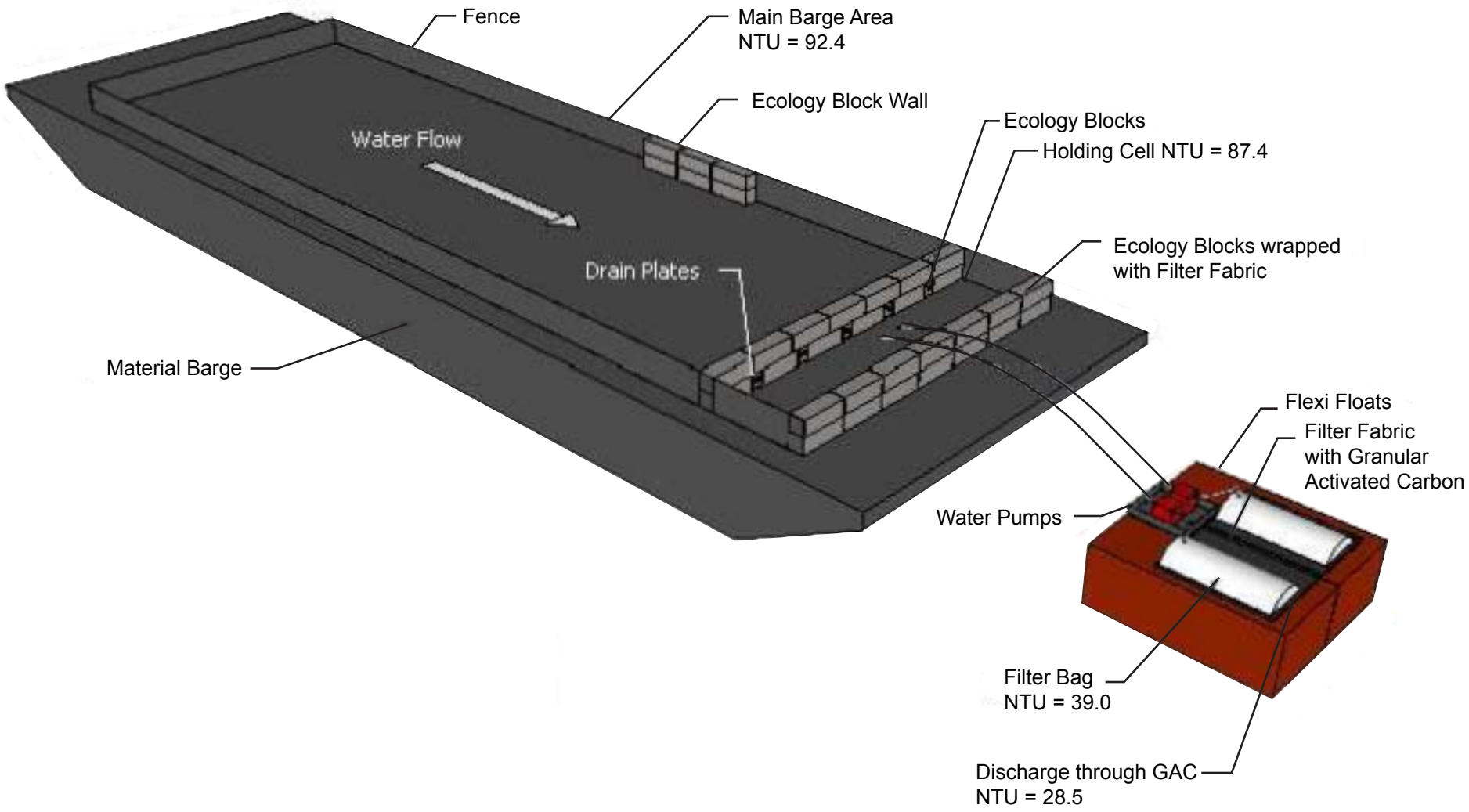
Figure 3-1.
Water Quality Compliance Monitoring
Target and Actual Locations – Conventional Parameters
Slip 4 Removal Action



Source: General Construction Company

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Figure 3-2.
Barge Dewatering Turbidity Sampling
Slip 4 Removal Action

N:\GIS\Projects\A0006 City of Seattle\14 Slip4\Production MXDs\RAComplianceRpt AppBWater\Fig3 3 BBermTurbidity 03302012.mxd - 7/2/2012 @ 5:00:43 PM

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Figure 3-3.
Boundary Berm Turbidity Sampling
Slip 4 Removal Action

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Figure 3-4.
Water Quality Compliance Monitoring
Target and Actual Locations – PCB and TSS Analysis
Slip 4 Removal Action

TABLES

Table 3-1. Water Quality Monitoring Results

Tide	Date	Time	Station	Water Depth (ft)	Turbidity (NTU) [a]	Dissolved Oxygen (mg/L) [a]	pH [a]	Salinity (ppt) [a]	Conductivity (µS/cm) [a]	Temp (^{0}C) [a]	Daily Notes	Time	
Flood	10/4/2011	11:40	Ambient	3	7	7.08	--	8.24	13790	13.4	Low Tide	5:06	
		11:49	Ambient	21.5	11	5.91	--	20.98	33491	11.97	High Tide	12:50	
		12:10	Compliance	3	6	8.51	--	6.72	11898	13.44	Low Tide	18:24	
		12:21	Compliance	23.3	8	6.47	--	21.01	33547	11.95	High Tide	23:07	
Slack	10/4/2011	12:58	Ambient	3	7	8.23	--	6.89	12732	13.51			
		12:59	Ambient	23.7	7	6.41	--	20.98	33489	11.97	Bank Excavation	8:30	16:30
		13:17	Compliance	3	11	8.08	--	8.57	14367	13.48			
		13:18	Compliance	20.5	9	6.51	--	20.94	33449	11.96			
Ebb	10/4/2011	14:20	Ambient	3	7	7.55	6.73	11.92	20500	13.64			
		14:22	Ambient	22.6	11	6.55	7.26	20.97	33491	11.96			
		14:41	Compliance	3	7	7.88	7.07	11.97	17454	13.25			
		14:42	Compliance	20	7	6.72	7.27	20.97	33516	12.01			
Slack	10/5/2011	14:14	Ambient	3	1.7	8.37	7.17	--	15706	13.35	Low Tide	6:17	
		14:16	Ambient	22.8	3	6.71	7.47	--	40550	12.11	High Tide	13:54	
		14:31	Compliance	3	2	8.12	7.26	--	14410	13.46	Low Tide	19:53	
		14:33	Compliance	18.5	2.5	7.11	7.51	--	40394	12.14			
Ebb	10/5/2011	15:39	Ambient	3	1.4	8.5	7.31	8.95	14776	13.36	Bank Excavation	7:45	15:00
		15:42	Ambient	22.6	2.8	6.7	7.54	25.97	40668	12.12			
		15:49	Compliance	3	2.5	8.41	7.33	8.9	15323	13.48			
		15:50	Compliance	20	3.1	6.29	7.57	26.03	40739	12.11			
Slack	10/6/2011	14:50	Ambient	3	2.1	11.09	7.15	8.02	14161	13.29	High Tide	0:39	
		14:52	Ambient	22.6	1.9	9.59	7.51	25.87	40496	12.12	Low Tide	7:27	
		14:59	Compliance	3	2.7	11.18	7.28	8.59	14527	13.37	High Tide	14:47	
		15:01	Compliance	22.3	3	9.8	7.61	25.94	40612	12.11	Low Tide	20:55	
Ebb	10/6/2011	WQ Monitoring not conducted									Bank Excavation Dredging	8:00 14:00	14:30 14:30
Flood	10/7/2011	11:34	Ambient	3	2.1	10.97	7.2	5.04	9033	13.17	High Tide	2:08	
		11:36	Ambient [b]	16	4.9	9.11	7.55	25.49	39630	12.16	Low Tide	8:30	
		11:57	Compliance	3	3	11.64	7.51	5.46	9638	13.26	High Tide	15:29	
		11:59	Compliance [b]	17.7	7.5	9.33	7.81	26.08	40802	12.15	Low Tide	21:41	
Slack	10/7/2011	16:00	Ambient	3	2.4	13.15	7.83	9.13	15702	13.15	Bank Excavation	7:00	10:10
		16:02	Ambient	22.5	2.5	12.12	8.15	26.28	41090	12.12	Bank Excavation	11:45	12:30
		15:40	Compliance	3	3.9	13.48	7.84	7.94	13695	13.32	Dredging	8:50	10:00
		15:42	Compliance	19.3	2.7	11.85	8.14	26.23	41029	12.13	Dredging	12:30	14:30
Ebb	10/7/2011	16:46	Ambient	3	2.6	10.45	7.88	13.07	21530	13.17			
		16:48	Ambient	21.9	1.9	9.01	8.19	26.26	41074	12.17			
		16:30	Compliance	3	3.6	10.35	7.92	12.06	20305	13.15			
		16:32	Compliance	18.8	2.6	8.6	8.15	26.13	40887	12.15			
Flood	10/10/2011	14:32	Compliance	3	2.2	8.45	6.51	6.35	8627	13.04	High Tide	5:06	
		14:34	Compliance	20.4	5.9	5.82	6.79	28.48	33107	11.86	Low Tide	10:48	
		14:46	Ambient	3	2.2	8.35	7.17	7.25	9302	13.06	High Tide	16:44	
		14:48	Ambient	20.3	5.2	5.85	6.99	28.54	33174	11.87	Low Tide	23:18	

Table 3-1. Water Quality Monitoring Results

Tide	Date	Time	Station	Water Depth (ft)	Turbidity (NTU) [a]	Dissolved Oxygen (mg/L) [a]	pH [a]	Salinity (ppt) [a]	Conductivity (µS/cm) [a]	Temp (^{0}C) [a]	Daily Notes	Time	
Slack (High)	10/10/2011	16:41	Compliance	3	2.3	8.09	7.21	7.43	9932	13.1			
		16:42	Compliance	22.8	4.5	5.84	7.14	28.6	33227	11.84	Bank Excavation	7:35	14:45
		16:50	Ambient	3	1.9	8.13	7.31	7.43	10171	13.16	Dredging	13:30	14:30
		16:53	Ambient	23.1	4.1	5.96	7.05	28.66	33243	11.84			
Ebb	10/10/2011	WQ Monitoring not conducted											
Ebb	10/11/2011	10:30	Compliance	3	3.5	8.42	6.56	7.22	9645	12.73	High Tide	5:47	
		10:32	Compliance	14.2	4.3	5.66	6.71	26.68	31322	12.02	Low Tide	11:25	
		10:56	Ambient	3	3.4	8.43	7.43	7.32	9732	12.75	High Tide	17:06	
		10:58	Ambient	14.7	4.1	5.88	7.37	26.53	31170	11.99	Low Tide	23:43	
Slack (Low)	10/11/2011	11:31	Compliance	3	3.3	8.38	7.57	7.41	9733	12.87			
		11:33	Compliance [b]	15.5	6.4	5.68	7.37	26.76	31285	12.01	Bank Excavation	7:30	14:30
		11:48	Ambient	3	3.2	8.4	7.64	7.4	9934	12.87	Dredging	9:30	13:00
		11:50	Ambient [b]	13	5.5	6.08	7.36	24.66	29115	12.11			
Flood	10/12/2011	15:01	Compliance	3	4.1	8.78	5.97	6.87	8432	12.93	High Tide	6:25	
		15:03	Compliance	19.6	4.1	6.00	6.27	28.65	33285	11.78	Low Tide	12:01	
		15:11	Ambient	3	3.9	8.41	6.99	6.13	8839	12.95	High Tide	17:29	
		15:14	Ambient	17	3.7	6.01	6.91	28.9	32186	11.85			
Slack (High)	10/12/2011	WQ Monitoring not conducted									Pile Removal	8:30	9:30
											Pile Removal	13:30	14:15
Ebb	10/13/2011	10:32	Compliance	3	2.8	8.76	6.71	5.18	6992	12.43	Low Tide	0:10	
		10:35	Compliance [b]	17.2	3.1	6.05	6.57	28.15	32723	11.81	High Tide	7:01	
											Low Tide	12:37	
		11:00	Ambient	3	3	9.01	7.45	4.76	6391	12.44	High Tide	17:56	
		11:03	Ambient [b]	16	2.4	6.14	6.94	27.96	32498	11.83			
Slack (Low)	10/13/2011	12:35	Compliance	3	3	8.61	7.3	4.51	6201	12.59	Dredging	10:15	11:30
		12:37	Compliance	17.6	3.1	6.08	7.03	27.05	31617	11.88	Bank Excavation	21:00	0:00
		12:53	Ambient	3	2.7	8.93	7.41	4.49	6184	12.74			
		12:55	Ambient	15	2.3	6.29	7.01	26.58	31081	11.91			
Ebb	10/14/2011	10:31	Compliance	3	2.4	8.85	6.22	5.1	6835	12.05	Low Tide	0:40	
		10:33	Compliance	17.6	3	6.18	6.62	28.43	32985	11.75	High Tide	7:38	
		10:45	Ambient	3	2.3	8.94	7.18	5.08	6814	12.03	Low Tide	13:14	
		10:47	Ambient	18.5	2.4	6.2	7.1	28.53	33058	11.75	High Tide	18:25	
Slack (Low)	10/14/2011	13:11	Compliance	3	2.7	8.91	7.47	4.7	6496	12.16			
		13:15	Compliance	16.7	3.4	6.4	7.3	26.98	28944	11.82	Bank Excavation	0:00	1:00
		13:25	Ambient	3	2.4	8.98	7.56	4.48	6119	12.16	Dredging	8:30	13:30
		13:28	Ambient	15.5	2.8	6.25	7.34	27.86	32403	11.78			
Ebb	10/17/2011	11:18	Compliance	3	2.5	8.72	7.18	6.76	8618	11.08	Low Tide	2:33	
		11:22	Compliance	20.4	3.3	5.84	7.14	29.04	33468	11.58	High Tide	9:51	
		11:37	Ambient	3	3.5	8.35	7.16	7.96	9871	11.15	Low Tide	15:29	
		11:40	Ambient	16.5	2.5	6	7.23	28.7	33137	11.59	High Tide	20:07	

Table 3-1. Water Quality Monitoring Results

Tide	Date	Time	Station	Water Depth (ft)	Turbidity (NTU) [a]	Dissolved Oxygen (mg/L) [a]	pH [a]	Salinity (ppt) [a]	Conductivity (µS/cm) [a]	Temp (^{0}C) [a]	Daily Notes	Time	
Slack (Low)	10/17/2011	15:17	Compliance	3	1.9	9.18	7.43	4.91	6482	11.46			
		15:20	Compliance	17.6	2.6	6.35	7.28	28.35	32801	11.61	Bank Excavation	12:45	13:45
		15:30	Ambient	3	2.1	9.17	7.45	4.79	6679	11.53	Dredging	7:50	14:00
		15:33	Ambient	17.3	2.1	6.2	7.42	28.48	32918	11.6			
	10/18/2011	WQ Monitoring not conducted											
Slack (High)	10/19/2011	11:47	Compliance	3	3.6	8.51	6.9	9.5	11991	11.59	Low Tide	4:12	
		11:49	Compliance	21.8	2.8	6.43	7.1	29.03	33417	11.54	High Tide	11:47	
		11:58	Ambient	3	4.4	8.35	7.18	8.71	10968	11.59	Low Tide	17:51	
		12:01	Ambient	20.9	2	6.48	7.18	29	33415	11.54	High Tide	22:10	
Ebb	10/19/2011	13:12	Compliance	3	7	8.47	7.39	7.94	9764	11.69			
		13:15	Compliance	20.4	2.5	6.17	7.4	29.02	33419	11.55	Dredging	7:30	14:00
		13:24	Ambient	3	6.6	8.03	7.18	8.68	11249	11.67			
		13:27	Ambient	19.8	2.3	6.18	7.48	28.91	33319	11.55			
	10/20/2011	WQ Monitoring not conducted											
Slack (High)	10/21/2011	13:31	Compliance	3	2.7	8.07	6.21	10.79	13589	11.74	Low Tide	6:14	
		13:34	Compliance	22.3	2.9	6.45	6.79	28.8	33213	11.54	High Tide	13:34	
		13:43	Ambient	3	2.3	8.07	7.12	9.88	13675	11.74	Low Tide	20:03	
		13:45	Ambient	22.2	2.2	6.5	7.23	28.78	33186	11.54			
Ebb	10/21/2011	15:05	Compliance	3	3	7.69	7.26	14.95	19818	11.7			
		15:09	Compliance	20.6	1.6	6.44	7.42	28.69	33085	11.54	Bank Excavation	7:10	12:00
		15:19	Ambient	3	2.4	7.96	7.43	11.63	14434	11.79	Dredging	7:30	10:00
		15:21	Ambient	20.3	2.1	6.44	7.44	28.73	33134	11.54			
Slack (High)	10/24/2011	15:22	Compliance	3	6.8	7.8	6.22	10.99	13943	12.33	High Tide	3:28	
		15:25	Compliance	22.7	2.9	6.44	6.92	29.01	33434	11.59	Low Tide	9:16	
		15:32	Ambient	3	4	8.05	7.13	8.57	11221	12.35	High Tide	15:25	
		15:35	Ambient	21.4	1.8	6.5	7.24	29.12	33568	11.6	Low Tide	22:06	
Ebb	10/24/2011	16:25	Compliance	3	3.7	8.3	7.24	7.66	10517	12.57			
		16:28	Compliance	21.6	2.1	6.48	7.23	28.93	33384	11.6	Dredging	13:00	15:00
		16:34	Ambient	3	3.4	8.31	7.42	7.78	10654	12.44			
		16:36	Ambient	19.5	1.6	6.54	7.32	28.89	33346	11.61			
	10/25/2011 to 10/27/2011	WQ Monitoring not conducted											
Slack (Low)	10/28/2011	13:08	Compliance	3	2.5	9.81	7	6.64	8231	9.68	Low Tide	0:11	
		13:11	Compliance	17.5	2.1	6.72	6.96	27.48	31566	11.21	High Tide	7:13	
		13:22	Ambient	3	2.5	9.54	7.38	7.31	9091	9.77	Low Tide	12:43	
		13:25	Ambient	17.2	2.1	6.61	7.31	27.47	31550	11.21	High Tide	17:56	
Flood	10/28/2011	14:48	Compliance	3	3.4	--	7.6	8.97	10924	9.89			
		14:51	Compliance	18.8	7.1	--	7.49	28.37	32520	11.25	Bank Excavation	8:45	12:00
		14:56	Ambient	3	2.3	9.82	7.74	8.62	10533	9.9			
		14:58	Ambient	20.4	5.3	--	7.55	28.57	32680	11.27			
	10/29/2011 to 10/31/2011	WQ Monitoring not conducted											

Table 3-1. Water Quality Monitoring Results

Tide	Date	Time	Station	Water Depth (ft)	Turbidity (NTU) [a]	Dissolved Oxygen (mg/L) [a]	pH [a]	Salinity (ppt) [a]	Conductivity (µS/cm) [a]	Temp (^{0}C) [a]	Daily Notes	Time	
Slack (High)	11/1/2011	11:21	Compliance	3	2.8	--	6.48	6.77	7856	9.43	Low Tide	3:27	
		11:25	Compliance	20.7	1.9	--	6.72	29.08	33201	11.2	High Tide	11:03	
		11:29	Ambient	3	2.5	--	7.05	8.11	9825	9.61	Low Tide	17:09	
		11:31	Ambient	23.2	1.5	--	7.01	29.07	33194	11.19	High Tide	21:39	
Ebb	11/1/2011	12:33	Compliance	3	2.1	9.88	6.48	3.91	5059	9.27			
		12:36	Compliance	21.5	1.7	6.5	6.44	28.95	33044	11.19	Bank Excavation	7:30	13:30
		12:37	Ambient	3	2.4	9.71	6.99	4.89	6150	9.38	Dredging	9:00	15:30
		12:39	Ambient	22.3	1.9	--	7.03	29.02	33143	11.2			
	11/2/2011	WQ Monitoring not conducted											
Slack (High)	11/3/2011	13:03	Compliance	3	6.1	9.77	6.63	5.99	7043	8.41	Low Tide	5:26	
		13:05	Compliance	21.6	1.4	6.47	6.63	39.8	43962	11.12	High Tide	12:59	
		13:15	Ambient	3	1.6	10.48	5.99	3.27	4090	8.34	Low Tide	19:46	
		13:18	Ambient	25.2	7	5.57	6.41	40.01	44153	11.15			
Ebb	11/3/2011	14:29	Compliance	3	5	10.07	5.87	4.96	6394	8.49			
		14:32	Compliance	21	1.5	5.75	6.11	39.55	43671	11.14	Bank Excavation	8:35	15:30
		14:41	Ambient	3	1.1	10.49	7.05	3.49	4367	8.27	Dredging	9:00	13:00
		14:44	Ambient	22.6	1	5.73	6.87	39.63	43807	11.14			
	11/4/2011 to 11/7/2011	WQ Monitoring not conducted											
Slack (High)	11/8/2011	14:46	Ambient	3	1.8	9.68	6.71	7.5	8676	8.01	High Tide	4:15	
		14:48	Ambient	22.5	2.5	6.25	7.03	28.02	31902	10.93	Low Tide	9:26	
		14:55	Compliance	3	2.4	9.48	7.31	8.49	9972	8.18	High Tide	14:48	
		14:57	Compliance	19.9	2.5	6.27	7.22	27.91	31778	10.89	Low Tide	21:44	
Ebb	11/8/2011	16:01	Ambient	3	1.4	10.09	7.15	5.54	6637	7.93			
		16:03	Ambient	22.2	1.7	6.35	7.06	28.03	31882	10.91	Bank Excavation	8:00	15:00
		16:08	Compliance	3	3.7	9.35	7.48	8.23	9646	8.17	Dredge	13:00	16:00
		16:11	Compliance	19.7	3.4	6.54	7.37	27.93	31799	10.88			
	11/9/2011	WQ Monitoring not conducted											
Flood	11/10/2011	14:45	Ambient	3	2.7	9.46	6.95	6.2	7648	9.15	High Tide	5:31	
		14:50	Ambient	21.9	1.5	7.42	7.52	27.86	31916	11.415	Low Tide	10:48	
		15:01	Compliance	3	2.9	9.22	6.94	7.27	8791	9.01	High Tide	15:43	
		15:05	Compliance	18.6	1.3	6.5	7.4	27.51	31528	11.13	Low Tide	22:40	
Slack (High)	11/10/2011	15:46	Ambient	3	1.1	9.41	7.3	6.57	7856	8.99			
		15:49	Ambient	23	1.5	6.34	6.45	28.16	32223	11.17	Bank Excavation	7:50	13:30
		15:55	Compliance	3	7.6	8.9	7.35	8.99	10710	9.2	Dredging	11:30	14:00
		15:57	Compliance	21.3	1.2	6.25	6.37	28.12	32201	11.15	Significant floating debris entering Slip		
	11/11/2011	WQ Monitoring not conducted											
Slack (High)	11/22/2011	13:30	Compliance	3	3.2	10.29	7.13	8.27	9258	6.62	High Tide	8:38	
		13:33	Compliance	23.8	1	6.16	7.5	41.9	45287	10.49	Low Tide	7:48	
		13:38	Ambient	3	3.9	10.42	7.43	8.07	9103	6.65	High Tide	13:36	
		13:40	Ambient	24.7	0.7	6.93	7.54	42.04	45440	10.51	Low Tide	20:40	

Table 3-1. Water Quality Monitoring Results

Tide	Date	Time	Station	Water Depth (ft)	Turbidity (NTU) [a]	Dissolved Oxygen (mg/L) [a]	pH [a]	Salinity (ppt) [a]	Conductivity (µS/cm) [a]	Temp (^{0}C) [a]	Daily Notes	Time	
Ebb	11/22/2011	14:58	Compliance	3	5.3	10.37	7.4	7.64	8696	6.6			
		15:01	Compliance	22.4	0.9	5.9	7.57	41.81	45155	10.49	Barge Decon	11:00	15:00
		15:05	Ambient	3	3.4	10.5	7.52	7.03	7933	6.47			
		15:07	Ambient	20.7	0.4	5.96	7.55	41.47	4805	10.45			
	11/23/2011 to 11/28/2011	WQ Monitoring not conducted											
Slack (High)	11/29/2011	8:46	Ambient	3	4.7	11.26	6.37	2.3	2809	6.48	Low Tide	1:10	
			Ambient	25	0.1	6.36	7.47	45.36	48172	10.15	High Tide	8:38	
		8:57	Compliance	2	4.7	11.22	6.6	2.26	2720	6.52	Low Tide	14:35	
			Compliance	23.4	0.1	6.25	7.49	45.13	47065	10.16	High Tide	19:12	
Ebb	11/29/2011	10:08	Ambient	3	5.1	10.99	7.21	2.47	2997	6.54			
			Ambient	24.5	0.2	6.34	7.52	45.08	47918	10.15	Pile Extraction	7:10	17:00
		10:20	Compliance	3	5.5	11.12	7.41	2.3	2824	6.53			
			Compliance	22.6	0.3	6.23	7.58	45.17	47967	10.17			
	11/30/2011	WQ Monitoring not conducted											
Slack (High)	12/1/2011	10:04	Compliance	3	2.1	11.45	7.05	2.13	2463	6.18	Low Tide	2:47	
		10:08	Compliance	23	1.2	6.48	7.51	45.02	47761	10.1	High Tide	10:08	
		10:12	Ambient	3	1.9	11.44	7.49	1.81	2277	6.16	Low Tide	16:53	
		10:14	Ambient	23.5	1.1	6.64	7.54	45.02	47786	10.12	High Tide	21:39	
Ebb	12/1/2011	11:36	Compliance	3	0.9	11.26	7.1	3.68	4362	6.39			
		11:39	Compliance	20.2	3.4	6.53	7.5	44.43	47194	10.06	Toe Berms	9:00	10:30
		11:43	Ambient	3	2.5	11.24	7.38	3.8	4502	6.38	Toe Berms	13:00	17:30
		11:45	Ambient	22.7	2	6.57	7.51	44.82	47572	10.1			
	12/2/2011 to 12/5/2011	WQ Monitoring not conducted											
Slack (High)	12/6/2011	13:33	Compliance	3	5.1	11.35	7.13	4.09	4571	4.59	High Tide	3:30	
		13:35	Compliance	20.7	0.09	6.21	7.4	44.86	47300	9.87	Low Tide	8:10	
		13:39	Ambient	3	0.9	11.41	7.44	4.47	4984	4.57	High Tide	13:23	
		13:41	Ambient	22.3	0.6	6.3	7.53	44.87	47415	9.88	Low Tide	20:41	
Ebb	12/6/2011	14:52	Compliance	3	3.2	10.88	7.22	8.64	7004	4.85			
		14:54	Compliance	19.3	1.1	6.34	7.51	44.82	47357	9.89	Filter Material	8:00	13:00
		14:56	Ambient	3	2.6	11.11	7.43	6.65	6998	4.85	Cap Armor	14:00	17:30
		14:58	Ambient	21.3	2.4	6.1	7.52	44.86	47404	9.88			
	12/7/2011	WQ Monitoring not conducted											
Slack (High)	12/8/2011	14:45	Ambient	3	1.2	10.87	7.2	11.25	7378	5.38	High Tide	4:59	
		14:48	Ambient	21.4	2.6	6.91	7.53	38.82	41366	9.58	Low Tide	9:58	
		14:52	Compliance	3	2	9.78	7.37	13.31	13771	6.5	High Tide	14:32	
		14:54	Compliance	21.1	1.9	6.77	7.52	38.7	41287	9.56	Low Tide	21:42	

Table 3-1. Water Quality Monitoring Results

Tide	Date	Time	Station	Water Depth (ft)	Turbidity (NTU) [a]	Dissolved Oxygen (mg/L) [a]	pH [a]	Salinity (ppt) [a]	Conductivity (µS/cm) [a]	Temp (^{0}C) [a]	Daily Notes	Time	
Ebb	12/8/2011	16:02	Compliance	3	1.6	10.42	7.04	10.84	11658	5.93			
		16:04	Compliance	19	1.5	6.94	7.45	38.6	41105	9.55	Filter Material	8:30	11:00
		16:06	Ambient	3	1.4	10.57	7.54	9.01	9432	5.67			
		16:08	Ambient	19.8	2.3	7.07	7.36	38.45	40906	9.54			
	12/9/2011 to 12/12/2011	WQ Monitoring not conducted											
Ebb	12/13/2011	9:03	Compliance	3	1.7	9.71	6.73	16.72	17492	5.88	Low Tide	0:06	
		9:05	Compliance	22.1	0.4	6.4	7.46	49.41	51182	9.5	High Tide	7:33	
		9:10	Ambient	3	0.7	9.49	7.24	16.3	16726	5.85	Low Tide	13:13	
		9:12	Ambient	22.7	0.2	6.19	7.58	49.34	51054	9.5	High Tide	17:44	
Slack (Low)	12/13/2011	13:19	Compliance	3	1.3	10.21	7.26	11.27	12072	5.45			
		13:21	Compliance	18.5	1.6	6.46	7.43	48.01	49489	9.31	Filter Material	8:30	12:00
		13:23	Ambient	3	1.7	10.21	7.48	11.36	12088	5.46	Cap Armor	13:30	17:30
		13:25	Ambient	18.9	1.2	6.44	7.53	47.8	49334	9.26			
	12/14/2011	WQ Monitoring not conducted											
Ebb	12/15/2011	10:12	Ambient	3	2.0	9.1	6.77	18.95	21945	6.43	Low Tide	1:28	
		10:14	Ambient	23	1.1	6.67	7.52	45.4	47321	9.38	High Tide	8:43	
		10:18	Compliance	3	3.9	9.7	7.45	15.03	15844	5.72	Low Tide	14:50	
		10:20	Compliance	18.7	1.3	6.41	7.54	45.37	47256	9.38	High Tide	19:35	
Slack (Low)	12/15/2011	14:41	Ambient	3	1.0	10.01	7.51	13.69	14440	5.73			
		14:43	Ambient	17.3	0.1	7.3	7.56	43.26	44999	9.08	Habitat Mix	8:00	15:00
		14:46	Compliance	3	1.7	9.96	7.62	13.73	14546	5.75			
		14:48	Compliance	15.7	2.3	7.24	7.49	42.37	44147	8.97			
	12/16/2011	WQ Monitoring not conducted											
Slack (High)	12/19/2011	11:23	Ambient	3	3.3	10.46	6.52	8.04	8957	6.1	Low Tide	4:55	
		11:25	Ambient	22.5	0.7	6.47	7.46	46.21	48151	9.45	High Tide	11:23	
		11:29	Compliance	3	1.6	9.93	7.41	8.5	9496	6.17	Low Tide	18:37	
		11:31	Compliance	22	0.9	6.55	7.5	46.06	47974	9.43			
Ebb	12/19/2011	12:49	Compliance	3	2.2	9.72	7.16	9.29	10517	6.37			
		12:51	Compliance	21.1	2.4	6.43	7.5	46.17	48019	9.4	Work Delay / Mechanical Breakdowns		
		12:55	Ambient	3	1.3	10.12	7.44	8.07	8431	6.35	Filter Material	15:00	16:00
		12:57	Ambient	22.4	0.5	6.45	7.42	46.04	47943	9.44			
	12/20/2011	WQ Monitoring not conducted											
Slack (High)	12/21/2011	12:56	Compliance	3	2.1	9.37	6.85	16.37	17675	7.13	High Tide	2:53	
		12:57	Compliance	20	0.3	6.68	7.49	43.76	45827	9.42	Low Tide	7:28	
		12:59	Ambient	3	1.2	9.41	7.45	12.78	14615	6.9	High Tide	12:56	
		13:02	Ambient	23.6	0.7	6.46	7.52	43.83	45883	9.41	Low Tide	20:18	

Table 3-1. Water Quality Monitoring Results

Tide	Date	Time	Station	Water Depth (ft)	Turbidity (NTU) [a]	Dissolved Oxygen (mg/L) [a]	pH [a]	Salinity (ppt) [a]	Conductivity (µS/cm) [a]	Temp (^{0}C) [a]	Daily Notes	Time	
Ebb	12/21/2011	14:21	Compliance	3	1.7	9.62	7.28	12.86	14088	6.89			
		14:23	Compliance	21.5	3.0	7.06	7.52	43.92	45984	9.42	Fix High Spots	8:30	11:30
		14:26	Ambient	3	0.9	9.81	7.48	10.57	11716	6.75	Swale Cap Armor	14:00	14:30
		14:27	Ambient	22.5	0.6	6.72	7.55	43.94	45993	9.43			
	12/22/2011 to 1/2/2012	WQ Monitoring not conducted											
Slack (High)	1/3/2012	11:40	Ambient	3	7.4	11.49	7.03	2.92	3383	5.61	River water is off-color (brownish)		
		11:42	Ambient	23.4	2.0	6.51	7.38	47.04	48476	9.1	High Tide	2:08	
		11:49	Compliance	3	7.4	11.37	7.75	3.08	3577	5.6	Low Tide	6:09	
		11:51	Compliance	21.9	1.7	6.32	7.49	46.96	48368	9.08	High Tide	11:52	
Ebb	1/3/2012	13:14	Ambient	3	7.5	11.52	7.15	2.65	3130	5.74	Low Tide	19:20	
		13:16	Ambient	22.9	1.5	6.37	7.49	47.07	48489	9.1			
		13:22	Compliance	3	9.2	11.43	7.72	2.87	3487	5.74	Waterway Cap	9:00	13:00
		13:25	Compliance	19.3	1.6	6.43	7.43	46.87	48177	9.04	Habitat Mix	13:00	15:00
	1/4/2012 to 1/9/2012	WQ Monitoring not conducted											
Ebb	1/10/2012	8:01	Compliance	3	3.6	11.04	6.95	4.37	4981	6.19	High Tide	6:29	
		8:04	Compliance	19.1	1.1	6.71	7.31	45.94	47106	8.78	Low Tide	12:03	
		8:06	Ambient	3	2.7	11.05	7.73	3.72	4384	6.08	High Tide	16:56	
		8:08	Ambient	22.6	0.7	6.75	7.53	46.03	47209	8.79	Low Tide	23:47	
Slack (Low)	1/10/2012	11:58	Compliance	3	8.3	10.84	7.09	5.13	5852	6.28			
		12:00	Compliance	17.5	2.7	6.95	7.36	41.05	41688	8.57	Waterway Cap	8:15	10:45
		12:03	Ambient	3	3.6	11.05	7.35	6.84	8651	6.37	Waterway Cap	13:15	16:15
		12:05	Ambient	17.2	1.6	6.84	7.56	43.83	45090	8.6			
	1/11/2012 to 1/23/2012	WQ Monitoring not conducted											
Ebb	1/24/2012	10:16	Compliance	3.0	**22.0**	11.16	6.67	7.44	7972	4.54	High Tide	6:20	
		10:18	Compliance	17.9	10.8	7.01	7.41	48.89	48328	7.75	Low Tide	12:06	
		10:20	Ambient	3.0	**4.6**	11.38	7.66	7.39	8134	4.48	High Tide	17:11	
		10:22	Ambient	19.9	5.8	7.07	7.56	50.28	49858	7.90	Low Tide	23:47	
Ebb	1/24/2012	11:30	Compliance	3.0	5.3	11.16	7.28	7.82	8407	4.54			
		11:32	Compliance	17.8	**19.5**	7.09	7.29	47.90	47493	7.68	Waterway Cap	7:00	11:30
		11:34	Ambient	3.0	7.0	10.85	7.57	10.30	10776	4.74	Waterway Cap	13:00	17:00
		11:36	Ambient	18.8	**3.6**	7.06	7.53	48.82	48230	7.77			
Outfalls	1/24/2012	11:49	NBF	1.0	20.4	--	--	--	--	--			
		11:52	I-5	1.0	38.1	--	--	--	--	--			
		12:09	NBF	0.5	15.7	--	--	--	--	--			
Slack (Low)	1/24/2012	12:13	Compliance	3.0	11.7	11.05	7.12	8.85	9403	4.74			
		12:15	Compliance	17.8	8.0	7.10	7.40	47.75	47610	7.69			
		12:18	Ambient	3.0	4.6	11.03	7.60	8.85	9332	4.68			
		12:20	Ambient	18.9	3.2	7.02	7.56	48.36	48109	7.72			

Table 3-1. Water Quality Monitoring Results

Tide	Date	Time	Station	Water Depth (ft)	Turbidity (NTU) [a]	Dissolved Oxygen (mg/L) [a]	pH [a]	Salinity (ppt) [a]	Conductivity (µS/cm) [a]	Temp (^{0}C) [a]	Daily Notes	Time	
Ebb	1/25/2012	9:57	Compliance	3.0	5.4	11.47	6.19	5.98	6533	4.86	High Tide	6:48	
		9:59	Compliance	20.0	5.1	7.03	7.36	51.09	50512	7.95	Low Tide	12:47	
		10:03	Ambient	3.0	4.1	11.34	7.41	6.58	7391	4.88	High Tide	18:00	
		10:05	Ambient	20.6	5.0	7.08	7.5	51.43	51991	8.01			
Slack (Low)	1/25/2012	12:40	Compliance	3.0	9.2	10.81	7.27	10.1	10672	5.43	Waterway Cap	7:00	11:30
		12:42	Compliance	16.7	17.9	8.10	7.45	38.47	40627	7.1	Waterway Cap	13:00	17:00
		12:47	Ambient	3.0	6.2	10.8	7.59	9.95	10692	5.43			
		12:49	Ambient	17.8	10.4	7.31	7.52	43.95	44504	7.45			
	1/26/2012 to 1/27/2012	WQ Monitoring not conducted											

Notes

[a] WQ measurements on 10/4/11 were collected using a Hydrolab MS5. WQ measurements from 10/5/11 to 11/08/11 were collected with a YSI 6920/650 MDS. WQ measurements from 11/11/2011 to 1/25/12 were collected with a replacement YSI 6920/650 MDS.

[b] Sample was sent for chemical analyses.

-- = No water quality measurements were recorded.
Bold = Indicates exceedance of 401 Certification Standard for turbidity (turbidity at compliance location in excess of 10 NTU over ambient turbidity).

Table 3-2. Analytical Results for Slip 4 Water Quality Monitoring Samples

		Sample ID	SW-02	SW-01	SW-01	SW-01	SW-02	SW-01	SW-01	SW-02
		Lab ID	SW0001	SW0002	SW0003	SW0010	SW0011	SW0012	SW0013	SW0014
		Sample Date	10/7/2011	10/7/2011	10/7/2011	10/11/2011	10/11/2011	10/13/2011	10/13/2011	10/13/2011
		Time	11:40:00 AM	12:05:00 PM	12:10:00 PM	11:35:00 AM	11:55:00 AM	10:40:00 AM	10:45:00 AM	11:05:00 AM
		Tide	Flood	Flood		Slack	Slack	Ebb		Ebb
		Station	Ambient	Compliance		Compliance	Ambient	Compliance		Ambient
		Depth (ft)[a]	16	17.7		15.5	13	17.2		16
Chemical Name	Method	Unit								
Field Parameters										
Turbidity	Field[b]	NTU	4.9	7.5		6.4	5.5	3.1		2.4
Dissolved Oxygen	Field[b]	mg/L	9.11	9.33		5.68	6.08	6.05		6.14
pH	Field[b]	pH	7.55	7.81		7.37	7.36	6.57		6.94
Salinity	Field[b]	ppt	25.49	26.08		26.76	24.66	28.15		27.96
Conductivity	Field[b]	µS/cm	39630	40802		31285	29115	32723		32498
Temperature	Field[b]	^{0}C	12.16	12.15		12.01	12.11	11.81		11.83
PCB Aroclors										
Aroclor 1016	SW8082	µg/L	0.010 *U*	0.010 *U*	0.010 *U*	0.010 *U*	0.010 *U*	0.008 *U*	0.010 *U*	0.010 *U*
Aroclor 1221	SW8082	µg/L	0.010 *U*	0.010 *U*	0.010 *U*	0.010 *U*	0.010 *U*	0.008 *U*	0.010 *U*	0.010 *U*
Aroclor 1232	SW8082	µg/L	0.010 *U*	0.010 *U*	0.010 *U*	0.010 *U*	0.010 *U*	0.011 *Y*	0.015 *Y*	0.010 *U*
Aroclor 1242	SW8082	µg/L	0.010 *U*	0.010 *U*	0.010 *U*	0.010 *U*	0.010 *U*	0.008 *U*	0.010 *U*	0.010 *U*
Aroclor 1248	SW8082	µg/L	0.010 *U*	0.010 *U*	0.010 *U*	0.010 *U*	0.010 *U*	0.008 *U*	0.010 *U*	0.010 *U*
Aroclor 1254	SW8082	µg/L	0.010 *U*	0.010 *U*	0.010 *U*	0.010 *U*	0.010 *U*	0.008 *U*	0.010 *U*	0.010 *U*
Aroclor 1260	SW8082	µg/L	0.010 *U*	0.010 *U*	0.010 *U*	0.010 *U*	0.010 *U*	0.008 *U*	0.010 *U*	0.010 *U*
Total Aroclors	Calculated	µg/L	0.010 *U*	0.010 *U*	0.010 *U*	0.010 *U*	0.010 *U*	0.011 *Y*	0.015 *Y*	0.010 *U*
Conventionals										
Total solids	E160.2	mg/L	12.5	20.8	21.3	11.1	10.7	7.2	7.9	5.1

Notes

[a] Depth below water surface.

[b] Field parameters were collected with a YSI 6920/650 MDS.

U - Indicates that the targeta analyte was not detected at the reported concentration.

Y - The analyte is not detected at or above the reported concentration. The reporting limit is raised due to chromatographic interference. The Y flag is equivalent to the U flag with a raised reporting limit.